Plant Archives Vol. 20, Supplement 2, 2020 pp. 3412-3415 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

IMPACT OF SEED PRIMING WITH INORGANIC CHEMICALS ON RICE SEEDLINGS (*ORYZA SATIVA* L.) UNDER SALINE CONDITION

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Abstract

The laboratory experiment was conducted at Seed Technology Laboratory, Department of Genetics and Plant Breeding at Annamalai University during 2018-2020 to study the effect of seed priming with various inorganic chemicals in rice (*Orya sativa* L.) cv. CO 51.Seed priming is a controlled hydration process that involved exposing seeds to low water potential which restricts germination. Priming is a method that might improve seed performance under the stress conditions such as drought or freshly harvested or aged seeds which might fail to germinate. The rice variety CO-51 is primed with $CaCl_2$, KNO_3, ZnSO4, Kcl, H_3BO_3 and KH_2PO_4 @ 1% concentration. The results revealed that (T_2) 1% $CaCl_2$ recorded significantly higher values for all the characters studied namely, germination percentage (%), speed of germination, root length (cm), shoot length (cm), seedling length (cm), dry matter production (g/10 seedlings), vigour index I and vigour index II under salinity stress condition.
***Keywords* :** Rice, seed priming chemicals, saline, Seedling characters.

Introduction

Rice is one of the staple food crops in South and Southeast Asia more than 90% of the world's rice is grown and consumed in Asia, where 60 % of the world's population lives. It is estimated that 40% of the world's population use rice as a major source of energy. Globally, rice ranks second only to wheat in terms of area harvested, but in terms of importance as a food crop, rice provides more energy per hectare than any other cereal crops. For almost three decades since the "Green Revolution", the rice yield growth rate was approximately 2.5 % per year. During the 1990's, however this has decreased to only 1.1%. (Riveros and Figures, 2000).

The total world area, production and productivity for rice is 159.17 million hectares, 472.16 MMT and 4.42 metric tons per hectare (World Agricultural Production, USDA, 2017). Major Rice producing countries are China, India, Indonesia, Bangaladesh, Vietnam, Thailand, Burma, Phillipines, Brazil and Japan. In India, Rice was cultivated in an area of 43.5 million hectares with a production of 104.41 MMT and productivity of 3.60 metric tons per hectare (Anon, 2017).

Seed priming is one of the techniques to obtain higher yield of rice by producing quality seedlings. Priming is a method that might improve seed performance under the stress conditions such as drought or freshly harvested or aged seeds which might fail to germinate. (Binang *et al*., 2012).

Good seed germination is very important for rice (*Oryza sativa* L.). Uneven or poor germination and subsequently uneven seedling growth can lead to great financial losses by reducing crop, though seed priming can increase speed and uniformity of germination (Ghiyasi *et al*., 2008).Seed priming treatments can lead to better germination and establishment in many field crops, such as maize, wheat, and rice. In another way seed priming could be defined as controlling the hydration level within seeds so that the metabolic activity necessary for germination can occur but radical emergence is prevented. Farooq *et al*. (2006) observed improved emergence, yield and quality of direct-seeded rice. (Mondal *et al*., 2011) postulated that the positive effect of rice seed priming was associated with an increase in endospermic amylase activity resulting from the increase insoluble sugar content of the primed seed. Invariably, the best priming method would depend on the type of stress the seed is exposed to (Yadav *et al*., 2011), as well as the genotype (Berchie *et al*., 2010).

Materials and Methods

Genetically and physically pure seeds of rice cv. CO 51 was obtained from Tamil Nadu Rice Research Institute (TRRI), Aduthurai for the study. Laboratory analysis was conducted at Seed Technology Laboratory, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University. The Plant Breeding farm was situated at 11 24' North latitude and 79 44' East longitude at an altitude of +5.79 m above mean sea level. The soil used for present study was clayey loam with a pH of 7.2 and EC of 4 (dSm^{-1}). The soil was low in available nitrogen, medium in available phosphorus and high in available potassium.

Seed Priming

The seeds were soaked in various chemical priming solutions at room temperature for 6 hours and dried back to the original moisture content and used for sowing.

Freshly harvested bulk seeds of rice were graded and imposed with the following chemical priming solutions. After the treatment, the seeds were shade dried and bring back to the original moisture content. The seeds were subject to evaluation under laboratory condition.

The seed treatments are:

T_0 - control

T_1 - Potassium nitrate(KNO_3) @ 1%

T_2 - Calcium chloride ($CaCl_2$) @ 1%

T_3 - zinc sulphate ($ZnSO_4$) @ 1%

T_4 - Potassium chloride (Kcl) @ 1%

T_5 - Boric acid (H_3BO_3) @ 1%

T_6 - Potassium Dihydrogen Phosphate (KH_2PO_4) @ 1%

Seed quality parameters

The following seed quality parameters were measured:

Germination percentage

Germination test was conducted with 4 x 100 seeds from each treatment in paper medium by roll towel method at 25±2° C and 95 ± 2 % relative humidity. At the end of 14 days, the number of normal seedlings was counted and the germination percent was calculated and expressed in whole number.

The germination percentage was calculated as follows:

Germination percentage (%)

$$= \frac{\text{Number of seed germinated}}{\text{Number of seeds put for germination}} X100$$

Speed of germination

A total of 4x100 seeds from each treatment were placed in the tray and allowed to germinate. The emergence was counted daily from 4th day of sowing until 14th day. From the mean per cent germination recorded on each counting date, speed of germination was calculated employing the formula suggested by (Maguire, 1962)

$$\text{Speed of germination} = \frac{X1}{Y1} + \frac{X2 - X1}{Y2} + \cdots + \frac{Xn - X(n-1)}{Yn}$$

Where,

X1- Number of seeds germinated at first count

X2- Number of seeds germinated at second count

Xn- Number of seeds germinated on nth day

Y1- Number of days from sowing to first count

Y2- Number of days from sowing to second count

Yn- Number of days from sowing nth count

Root length (cm)

Ten normal seedlings taken at random from the germination test were used for measuring root length. It was measured from the collar region to the tip of the primary root and the mean value is expressed in cm.

Shoot length (cm)

Ten normal seedlings used for root measurement were measured for shoot length from the collar region to the tip of the plumule and the means value is expressed in cm.

Seedling length (cm)

Ten seedlings from each replication kept for germination were taken at random on final count. The seedling length measured from the tip of the primary root to the tip of the primary leaf and mean of ten seedlings is calculated and expressed in cm.

Dry matter production (g/10 seedlings)

Ten normal seedlings used for growth measurement were placed in a paper cover and shade dried for 24 h, then kept in the hot air oven maintained at 85 ºC for 24 h. The dried seedlings were cooled in a desiccator for 30 minutes and expressed in g / 10 seedlings.

Vigour index I

The vigour index I was computed adopting the procedure of Abdul Baki and Anderson (1973) and expressed as whole number.

Vigour index I = Germination Percentage X Total Seedling length (cm)

Vigour index II

The vigour index II was computed adopting the procedure of Abdul Baki and Anderson (1973) and expressed as whole number.

Vigour index II = Germination percentage X Dry matter production (mg)

The treatments were evaluated for seed quality parameters *viz*., germination (%), shoot length (cm), root length (cm), dry matter production (g seedling^{-10}) and vigour index I and vigour index II. The experiment was arranged in a completely randomized factorial design and replicated 3 times. Seed were considered germinated when the radicle was twice the length of the seed. Seeds were evaluated for germination percent Germinability was recorded after 14 days of sowing (DAS) and the number of seeds germinated expressed as germination percentage. At 14 DAS seedlings from each replication removed at random. Shoot length was measured from the collar region to the tip of the longest leaf. Root length was measured from the base of the stem to the tip of the longest root. The seedling vigour index was calculated using the formula of Abdul – Baki and Anderson (1973). All the data were analysed statistically with appropriate tools and expressed as mean values.

Results and Discussion

Among the treatments, the maximum germination percent was observed in treatment T_2 (93%) followed by T_4 (91%)(Table 1). The control T_0 was inferior in germination (80%) when compared to other treatments. Higher germination per cent in T_2 may be due to the benefits of priming which may be due to number of physio chemical changes occur that modify the protoplasmic characters, increasing the embryo physiological activity and associated structures (Ganesh *et al.*, 2013). For the trait, speed of germination was maximum in treatment T_2 (9.82) followed by T_4 (9.21) speed of germination T_2 of the primed seed could be due to the fact that such advanced seed would retain viability to carry on where they left off upon germination (Joseph and Nair, 2014). The control T_0 was inferior (7.08) when compared to other treatments. The root length found to be the maximum in the treatment T_2 (18.10cm) followed by the treatment T_4 (17.65cm). The root length was the minimum in the control T_0 (16.08cm). The Treatment T_2 showed the maximum shoot length (13.07cm) followed by T_4 (12.91cm) whereas the control T_0 recorded the minimum shoot length (10.71cm). The improvements in seedling length (both root length and shoot length) may due to the enhanced metabolic activity which induces elongation of cells they by increasing root and shoot length (Ganesh *et al.,* 2013).

Among the treatments, the maximum seedling length was observed in the treatment T_2 (31.17cm) followed by T_4 (30.57cm). The minimum seedling length was observed in control T_0 (26.79cm). The maximum dry matter production was observed in treatment in T_2 (0.20g) followed by T_4 (0.18g). The control T_0 was inferior (0.12g) when compared to other treatments. The increased dry matter production over the control might be due to simultaneous effect of repair mechanism induced by priming and synchronized earlier germination that makes seedling entry into the autotrophic state well in advance to produce more photo assimilate from source to sink there by increases the dry matter production. This was in conformity with earlier work of Shah (2012)(Fig 1).Vigour index I was maximum in treatment T_2 (2899.13) followed by T_4 (2781.86). The control T_0 was inferior (2196.80) when compared to other treatments. The vigour index II was found to be the maximum in the treatment T_2 (18.60) followed by the treatment T_4 (16.38). The vigour index II was the minimum in the control T_0 (9.85). The higher vigour index due to the benefits effects of $CaCl_2$ in strengthening the cell membrane integrity and permeability (Chrysiansen and Foy, 2009).

Table 1: Effect of seed priming on seedling parameters in rice cv. CO-51.

Treatments	Germination percentage (%)	Speed of germination	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Dry matter production (g/10 seedlings)	Vigour index I	Vigour index II
T_0	82(64.90)	7.23	16.08	10.71	26.79	0.12	2196.80	9.85
T_1	87(68.87)	8.04	16.73	11.40	28.13	0.16	2447.59	13.92
T_2	93(73.58)	9.82	18.10	13.07	31.17	0.20	2899.13	18.60
T_3	86(67.21)	7.76	16.23	11.12	27.36	0.15	2352.67	13.19
T_4	91(71.55)	9.21	17.65	12.91	30.57	0.18	2781.86	16.38
T_5	85(66.42)	7.50	16.13	11.03	27.16	0.14	2309.17	12.18
T_6	89(69.73)	8.31	16.94	11.91	28.85	0.17	2568.22	15.42
Mean	87.57(69.91)	8.27	16.84	11.74	28.58	0.16	2507.92	14.22
S.Ed	0.21(0.20)	0.30	0.02	0.03	0.03	0.01	5.72	0.16
C.D.(P=0.05)	0.45(0.42)	0.63	0.03	0.05	0.07	0.02	12.30	0.35

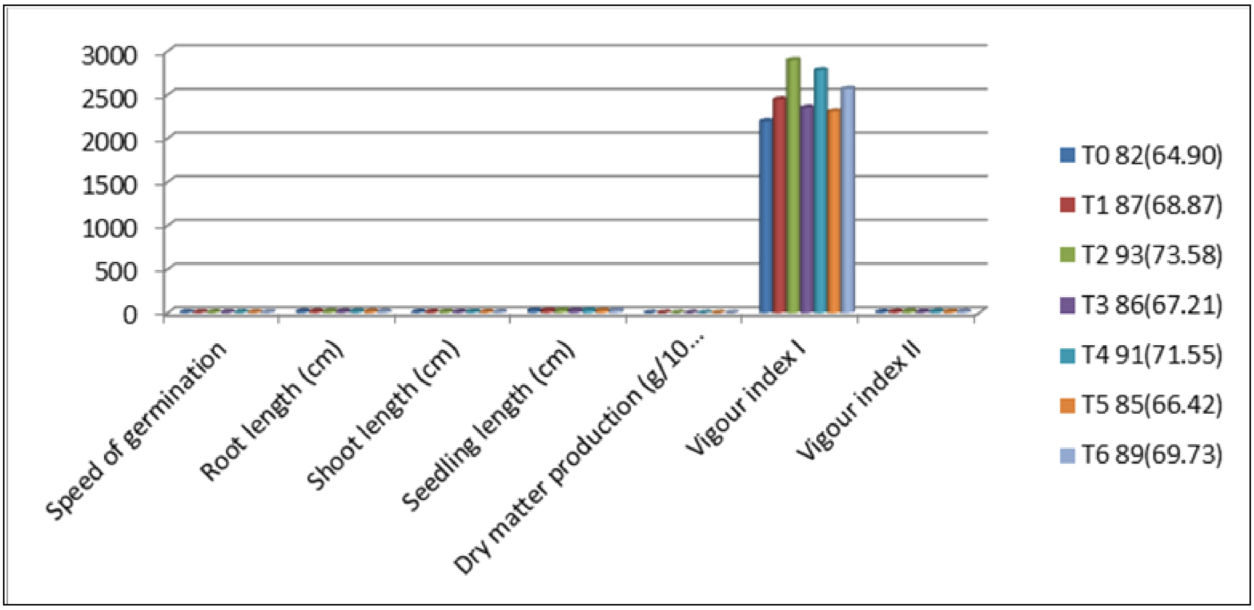

Fig. 1: Effect Of Seed Priming On Initial Seedling Parametres In Rice Cv.Co-51.

It was concluded that, when compared to other treatments, (T_2) 1% $CaCl_2$ recorded significantly higher values for all the characters studied namely, germination percentage (%), speed of germination, root length (cm), shoot length (cm), seedling length (cm), dry matter production (g/10 seedlings), vigour index I and vigour index II in the rice variety C0-51.

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